

# GRAVITY SEPARATION

## SGS MINERALS SERVICES

SGS Lakefield Orestest Pty Ltd (SGS) was originally founded in 1993 as Orestest Pty Ltd. SGS has since developed into a major metallurgical services organisation located in a purpose-built laboratory in Perth, Western Australia.

The laboratory is dedicated to providing high quality metallurgical testing across the broad spectrum of the minerals industry including:

- Gold ores
- Nickel laterites
- Base metal
- Iron ore
- Mineral sands
- PGM ores
- Rare-earths and other exotics
- Diamond ores
- Environmental services



SGS provides a comprehensive range of test work capabilities including bacterial leaching, crushing, screening, grinding, ultra fine grinding, gravity, magnetic & electrostatic separation, solvent extraction, electrowinning, flotation, pressure leaching, pressure oxidation, pressure acid leach and cyanide speciation. Pre-feasibility studies, on-site diagnostic metallurgical services, environmental testing and analytical services are also included in our range of capabilities.

## INTRODUCTION

Gravity separation, one of the oldest separation techniques, has become increasingly popular with new equipment enhancing the range of separations possible, which when coupled with generally low capital and operating costs and lack of chemicals to cause environmental concerns, often provides an attractive process.

Gravity separation relies upon the differences in density of minerals to provide efficient separation. The ease and efficiency of separation is dependent on a number of factors including relative density, particle size and shape, liberation etc, all of which affect the selection of equipment type.

## WHY USE GRAVITY SEPARATION?

Gravity separation is the best proven and accepted technique of concentrating minerals and has been used as a primary form of mineral concentration for centuries. Due to its high efficiency and low cost, gravity separation is always the first consideration in any flowsheet development program and always features in any flowsheet where there is sufficient differences between the specific gravity of the valuable and gangue minerals.

In the case of gold and PGE, gravity separation can quickly generate a precious metal concentrate that can be sold direct to refineries, resulting in better payment terms, faster payback and immediate cash-flows. The small footprint of these gravity plants means less capital outlay and better security for these small volume high-value concentrates.

SGS Minerals Services has significant expertise using these techniques to treat a wide range of commodities including gold, tin, tantalum, lead/zinc, platinum and mineral sands.

In certain circumstances, dense media separation followed by complex gravity circuits in conjunction with multi gravity separation and/or other separation techniques, is required to provide effective low cost solutions to allow the optimal economic recovery of complex ores.

With our array of equipment and experience, we can readily provide bankable cost effective processing flowsheets and advise on operational best practices during plant start up based on our extensive production experience.

## **REASONS TO ASSESS GRAVITY SEPARATION**

- To reject barren waste as an initial pre-concentration step.
- To recover malleable and/or friable coarse heavy minerals from grinding circuit circulating loads. Such minerals are otherwise hard to recover after regrinding.
- To pre-concentrate heavy minerals to minimize downstream processing costs.
- To concentrate heavy minerals.
- To clean low weight yield bulk concentrates.
- To scavenging plant tailings.
- To generate a precious metal concentrate that can go direct to a refinery rather than a smelter.

## **EXPERTISE AND INNOVATION**

While gravity separation is a well-proven technique to mineral processing, careful attention to operating conditions and feed preparation can pay significant dividends.

Recognizing the fact that efficient gravity separation is a function of particle size and specific density differences, SGS Minerals Services' metallurgical group has developed several successful techniques to identify feed size preparation criteria to maximize downstream gravity separation efficiency. This has proven to enhance concentrate grades by 5-10%. For instance, the introduction of Multi Gravity Separation techniques in a tin recovery plant as a replacement for the last flotation cleaner increased recoveries 10% and, in an other instance, use of specialist techniques and procedures increased tin recoveries by 8% .

Release Analysis is used as the preferred data collation and presentation tool wherever appropriate to assess the mineral release from gangue at particle sizes below 1mm.

## **Areas of Applicability**

- Precious Metals (Au and PGE)
  - Creation of a direct refining vs. to-smelter concentrate
  - Gravity recovery from grinding circuits
  - Separation from base metals and gangue
  - Separation from gangue
  - Recovery from tailings



- Mineral Sands
  - Separation of ilmenite, rutile and monazite from beach sand
- Recycling
  - Separation of metallic zinc and lead from recycled batteries
  - Separation of steel from waste
  - Slag re-processing
  - Precious metal recovery from shredded circuit boards
  - Copper recovery from shredded copper cable
  - Precious metal recovery from dusts.
- Garnet
  - Separation of garnet from biotite, magnetite and quartz
- Rare Earths
  - Separation of eudialyte and monzonite from gangue
- Industrial Minerals
  - Separation of graphite from mica
  - Separation of muscovite from gangue
  - Separation of kaolinite from muscovite
  - Silica sand cleaning

## **FACILITIES AT SGS**

### **Conventional Jigs**

Conventional jigs are often used to recover heavy minerals that are liberated at a coarse particle size from crushing / grinding circuits, thus avoiding subsequent over- grinding and loss. SGS has a number of jigs, which can be used to evaluate the application of a conventional jig for this purpose, and also process bulk samples.

### **Centrifugal Jigs**

Centrifugal jigs use enhanced forces generated by their spinning motion to enable finer particle sizes and closer SG minerals to be separated. SGS has at hand a range of jigs including a Kelsey (J200) which is one of the more common examples of this type of separator.

### **Spirals (including pilot plant facility)**

Spirals are one of the oldest gravity separators. SGS has a range of types including low grade, medium grade, high grade and fine mineral models from the Roche MT, Multotec and Carpc ranges.

In addition to individual closed circuit spiral tests SGS can also carry out bulk sample pilot plant runs on a continuous basis from mine site ore through to heavy mineral concentrate to produce bulk final concentrates for further tests, in a newly constructed facility.

Bulk parcels of ore can be fed at a controlled rate of up to 6 t/h into a rotary scrubber / trommel to break up clays and remove oversize, with the undersize being pumped to a de-sliming hydrocyclone, prior to feeding to a three stage gravity separation spiral circuit.

A rougher / cleaner / scavenger stage spiral plant with associated pumps and hoppers is able to produce a final concentrate and tailings with recycling loads in order to simulate a plant and to provide accurate mass balance data. The tails and slimes are de-watered by cyclone and settling tanks respectively to allow recycling of process water and economical disposal locally.



### **Mozley Gravity Separator (MGS)**

This is a low capacity high performance gravity separator suitable for treating difficult fine particle feeds below 75 microns. SGS has a pilot size unit available.

### **Falcon Concentrator**

This is a centrifugal type gravity separator also suited to fine particle size feeds. SGS has both the continuous C200 pilot size unit, and batch SB 40 units available.

### **Shaking Tables**

Separation on Shaking Tables is influenced by particle shape and size. As feed size increases, the efficiency of separation decreases. Separation can be controlled by a number of operating variables, such as water flow, feed pulp density, deck slope, amplitude and feed rate.

SGS has one half-size Wilfley Table and two quarter size tables available for gravity separation test work. Each table has an adjustable deck slope, stroke length and water and feed rates.

The larger deck is suited to larger particle sizes or particles which are flat and do not roll easily. Conversely the smaller tables are suited to smaller sizes or to particles which separate efficiently.

### **Knelson Concentrator**

This separator is a small batch type comparable in some respects to the SB Falcon concentrator.

### **CLIENT LIST**

- Iluka Resources Ltd – pilot plant processing of Western Australian and Murray Basin ores.
- Doral Mineral Sands Ltd – pilot plant processing of Western Australian ores.
- Gippsland Ltd – pilot plant processing of tantalum ore.
- Newcrest Mining Ltd – continuous gravity recovery of gold.
- Hamersley Iron Pty Ltd – upgrade of detrital orebody material.
- BHP Billiton Iron Ore – treatment of feed to HBI and HYL direct reduction plants.
- Sons of Gwalia – scavenging of tantalum from plant tailings.
- CVRD Ltd – recovery of chromite from laterite nickel screen oversize.
- ProMet Engineering Ltd – Treatment and upgrade of detrital iron ore orebody material.
- Consolidated Minerals – Treatment and upgrade of iron ore.

For more information, please contact us:

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The image shows the SGS logo, which consists of the letters 'SGS' in a large, bold, grey sans-serif font. A thin vertical orange line is positioned to the right of the letters, and a thin horizontal orange line is positioned below the letters, forming an L-shape that frames the bottom-right corner of the text.